Sensata Technologies

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ISO 9001:2000 Registered Company

DIMENSIONS™

DC to AC Power Inverters

Owners Manual for Models:

12U11F

Including Options: B3 & T

Table of Contents:

Safety Instructions

Important: Read this manual before installation, it contains important safety, installation, and operating instructions. Save this manual and keep it in a safe place.

1.1 Warning and Danger Symbols:

To reduce the risk of electrical shock and to ensure the safe operation of your Dimensions power inverter, the following symbols are used throughout the manual.

ATTENTION:	**DANGER:**
 Important operating instructions. Follow them closely.	 Risk of personal harm and/or electrocution exists in this area. Use extreme caution.

1.2 Inverter Precautions:

- Inverters produce hazardous voltages. To avoid risk of harm or fire, the unit must be properly installed.
- There are no user serviceable parts inside, do not remove the cover.
- The inverter should not be mounted in a location that may be exposed to rain or spray.
- The inverter should not be installed in a zero clearance enclosure.
- Damage to the inverter will occur if correct polarity is not observed when installing the DC input cables.
- Damage to the inverter will occur if an external AC power source is applied to the inverter's AC hardwire output.
- The inverter contains a circuit breaker and capacitor that may produce a spark. Do not mount in a confined battery or gas compartment.
- Be sure the inverter is turned OFF during installation.

1.3 Battery Precautions:

- Working in the vicinity of lead-acid batteries is dangerous. There is a risk of acid exposure.
- Batteries generate explosive gases during operation.
- There is risk of high current discharge from shorting a battery that can cause fire and explosion. Use insulated tools during installation.
- Remove all rings, watches, jewelry or other conductive items before working near the batteries.
- Inspect the batteries once a year for cracks, leaks or swelling.
- Dispose of the batteries according to local regulations. Do not incinerate batteries; risk of explosion exists.

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Specifications

Millennium Series Power Inverters

12U11F

Output Voltage (VAC)	220 RMS ±5%
Output Frequency:	50 Hz ± 0.05%
Output Waveform:	Quasi-sine wave, with waveform stabilizer
Input Voltage: (VDC)	11 to 14
Operating Temperature:	-20° to 40° C (0° to 104° F)
Efficiency:	Up to 93%

Environmentally Friendly, Quiet, Reliable, AC Power

Other Design Features:

- Thermally-controlled cooling fan
- Enclosed AC and DC cable connections with strain relief
- Remote ON/OFF switch hookup
- LED for Inverter Power, Low Input Voltage, High Temperature, & Overload
- Battery voltage indicator with push-to-test
- Optional Battery Charger “B3” and Transfer Relay “T”

Unit Protection:

- Automatic electronic short circuit/overload protection
- Automatic high temperature shutdown
- Output circuit breakers

Battery Protection:

Automatic low battery shutdown at 10.5 VDC (with in-rush delay)

MODEL NUMBER	12U11F
Output Power (Watts Cont.)	1,100
Output Current (Amps AC)	Up to 5
Peak Output (Amps AC)	15
Output Rating: (hp)	¼
Input Current (Amps DC)	Up to 110
Weight (lbs.)	31
Dimensions LxWxH – (In.)	13¼ x 11 x 6¾
BATTERY CHARGER “B3” (Optional)	3 step charger with automatic conditioning; Temperature compensated output voltage; selectable between wet and sealed lead acid batteries; selectable between small and large battery banks
Output Current (Amps DC)	40
Input Current (Amps AC)	Up to 6
TRANSFER RELAY “T” (Optional)	Fail-safe shore power Transfer Relay
Current Rating (Amps AC)	15
Transfer Time (milliseconds)	Less than 35 typical

- **Usage:** Any 120 VAC, 60 Hz single-phase products within the inverter’s power rating that does not require a pure sine waveform.

Technical Description

3.1 DC to AC Inverter:

A DC to AC inverter converts DC power from batteries to usable 220 VAC, 50 Hz power. The direct current (DC) that enters the inverter is filtered by a large input capacitor and switched “On” and “Off” by Metal Oxide Silicon Field Effect Transistors (MOSFET) at a rate of 60 cycles per second, and directed into the transformer which steps the voltage up to 220 volts. The unit has a Digital System Processor (DSP) to control the output voltage and frequency as the DC input voltage and/or output load varies. The signal output waveform shape is not sinusoidal; it has a total harmonic distortion of 31% and a maximum single harmonic distortion of 25%.

3.2 Transfer Switch – “T” Option:

If the inverter has the transfer switch feature, 220 VAC, 50 Hz external power can be applied directly to the inverter input by hardwire connections to the AC input wire leads provided in the hardwire compartment. When external power is present, the internal transfer switch automatically turns the DC to AC inverter OFF. At this time the loads attached to the inverter output will operate directly from the external power line even if the inverter was turned OFF manually. The internal transfer relay automatically switches the inverter back to “inverter power” mode in the absence of external power whenever the inverter was previously set to ON.

3.3 Battery Charger – “B3” Option:

Inverters having the three-step battery charger feature require the transfer switch “T” option to operate. External power 220 VAC, 50 Hz is applied as explained in 3.2. The internal transfer switch automatically turns the DC to AC inverter OFF and turns the three-step built-in battery charger ON. The battery charger cannot be defeated at this time and will engage even if the inverter has been set OFF manually.

The 3-step charging process goes through the following stages: The bulk stage, here the electrical current is returned to the batteries until a factory set voltage limit is reached. The acceptance stage is then engaged immediately; the battery voltage is kept constant while decreasing the charging current gradually up to the transition point or when it reaches the pre-set timer limit. In the floating stage the batteries are recharged at a very low current rate to prevent them from self-discharging. Finally the condition stage is engaged every 10^{th} complete battery charging cycles to ensure full restoration of active materials in all the plates of the battery cells.

The inverter has an automatic power sharing feature that automatically decrease the battery charger output so that the total AC input of the inverter for both the AC loads and the battery charger does not exceed the 15 amp input circuit breaker. If the loads exceed 15 amps, the charger will be at zero amp draws and the input circuit breaker will trip. The battery charger draw will automatically increase when the external loads are reduced if the batteries will accept more current.

Inverter Physical Description

4.1 Inverter

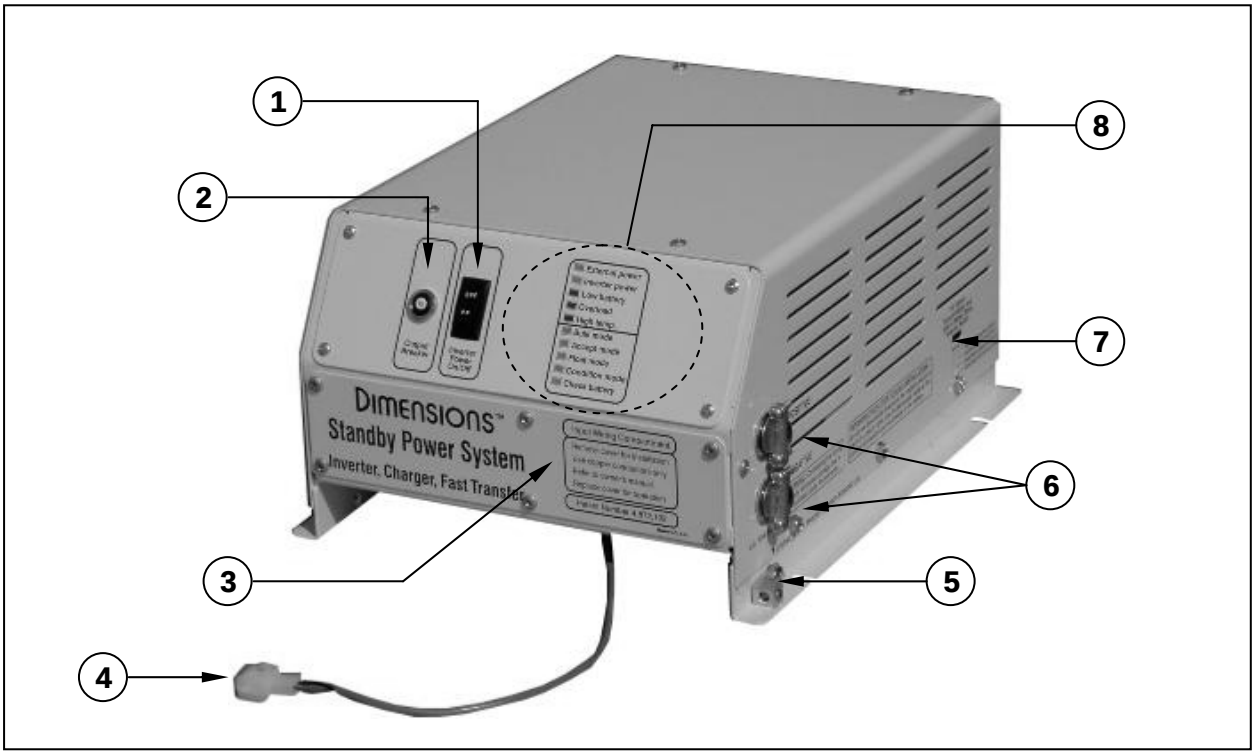


FIGURE 1: Chassis physical description

Item #	Description	Function
1	"On/Off" Switch.	Turns the inverter ON/OFF
2	Output Breaker – 15A	Trips to protect the inverter from hardwire AC output short circuit or overload.
3	Field Wiring Compartment Cover	Remove the faceplate to access the AC Input/Output lead wires and DC field-wiring compartment.
4	Temperature Compensation Probe Connector	Connects to the remote temperature sense probe. Available with the "B3" option only.
5	Bonding Lug	Connects to the ground system.
6	DC input entry opening	Allows the DC cables to reach the DC input terminal connector.
7	Battery Capacity Selector Switch	Sets the correct battery type and the capacity of the battery bank for proper charging. Available with "B3" option only.
8	LED Status Panel	Provides inverter status – See next page

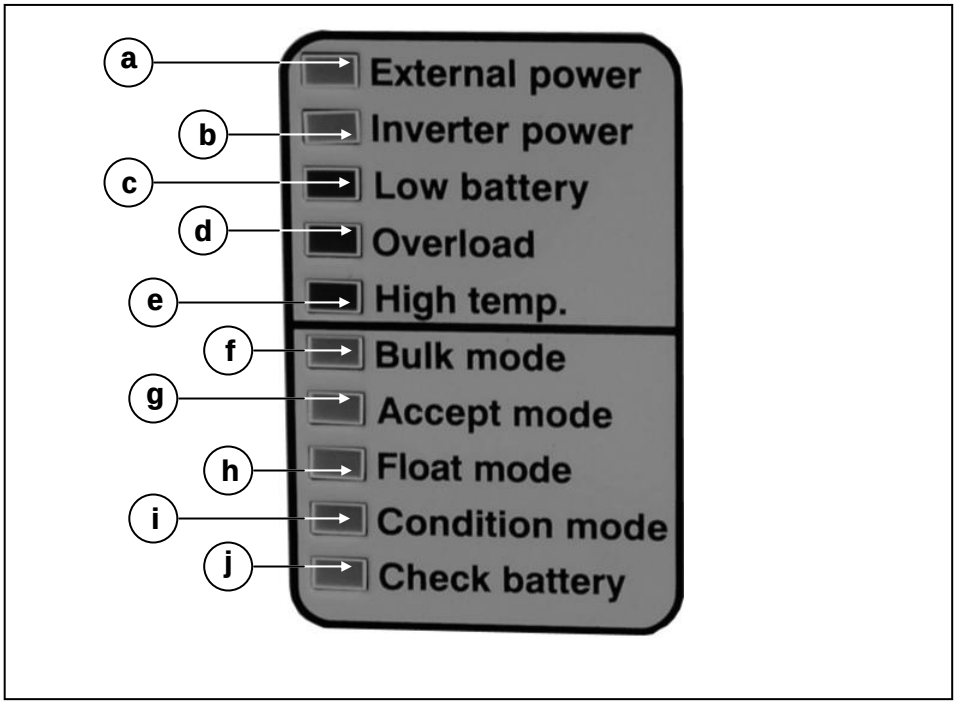


FIGURE 2: LED Status Panel

(a) **External power:** The green LED indicates that there is external 220 VAC, 50 Hz connected to the unit. This light is activated on models that have the "T" option.

(b) **Inverter power:** The green LED indicates that the unit is operating from batteries in the inverter mode.

(c) **Low battery:** The red LED indicates that the inverter is in a low battery voltage condition.

(d) **Overload:** The red LED indicates that the inverter is in an overload condition.

(e) **High temp:** The red LED indicates that the inverter has a high internal temperature.

(f) **Bulk mode:** The green LED indicates that the battery charger is in the bulk mode. "B3" option only.

(g) **Accept mode:** The green LED indicates that the battery charger is in the acceptance mode. Available with the "B3" option only.

(h) **Float mode:** The green LED indicates that the battery charger is in the float mode. Available with the "B3" option only.

(i) **Condition mode:** The green LED indicates that the battery charger is in the condition mode. Available with the "B3" option only.

(j) **Check battery:** The yellow LED indicates a possible fault in the battery bank or DC cables. Available with the "B3" option only.

Installation

5.1 Tools for Installation:

Tools required for installation: Connectors (butt type and insulated), drill, Crimpers (for insulated and non-insulated connectors), volt meter with probes, electrical tape, #2 Phillips screwdriver, straight screwdriver, wire cutters, wire strippers, cable ties, tape measure.

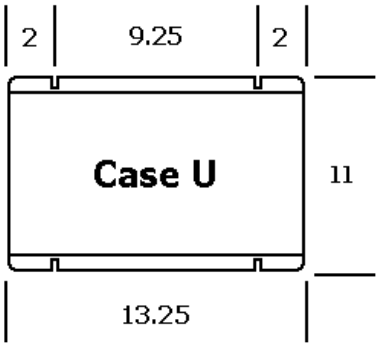
5.2 System Components:

Picture	Model and Description	Qty.
	12U11F, 12U11FT, 12U11B3FT	1
	Temp. Comp. Cable 611440-XX (“B3” option only) XX: Length of the cable in feet	1

5.3 Mounting the inverter:

⚠	*The inverter mounting location should provide adequate ventilation and clearance to maintain room temperature during operation. At least 1/2 inch of clearance is required on all sides.*

- Locate a suitable, secure vertical or horizontal mounting surface as close to the batteries as possible without being in the same airtight compartment.



All dimensions are in inches

- If mounting the inverter on a vertical surface, it is recommended that the front control panel be pointing down whenever possible.
- Locate the mounting holes on the chassis flanges and fasten them using ¼ inch diameter screws to secure the inverter. See figure 3.

5.2.1 Chassis Bonding Lug: Connect the bonding lug located at the right side of the inverter chassis to the earth grounding system using an 8-gauge copper wire.

Figure 3: Inverter footprints

5.2.2 Temperature Compensation Sense Probe: If the inverter has the battery charger “B3” option, connect the probe to a negative post of the battery bank. Failure to connect the remote temperature sense probe correctly will result in improperly charged batteries.

Inverter Wiring:

6.1 DC Wiring:

1 It is recommended in all cases to use stranded copper wires.
2 Use SGX cross-linked polyurethane insulation type that complies with the high temperature insulation requirements (125°C.) of SAE J-1127 and vehicle manufacturer requirements.
3 Wire gauge recommendations are minimum. For higher temperature rated applications inside engine spaces or large motor loads and other applications with high surge currents use wire gauge 1 to 2 sizes larger than shown on table I.
4 Keep the wire runs between battery and inverter as short as possible.
5 Use Bussmann fuse type ANN-XXX and fuseblock # 3576 where XXX is the size of the fuse.

6.1.1 Inverter Cable: This is the cable assembly that runs from the inverter to the batteries. Estimate the "inverter cable" length and locate your inverter model on table I, cross-reference the wire gauge and fuse size.

Table I: Wire and Fusing Guide for 12VDC systems at 5% Voltage Drop at Full Output

Inverter Model	Full Load (Amps DC)	Inverter to battery estimated cable length in feet		
		1' – 10'	11' – 15'	16' – 20'
12U11F	110	4 gauge, 200A	2 gauge, 250A	1 gauge, 300A

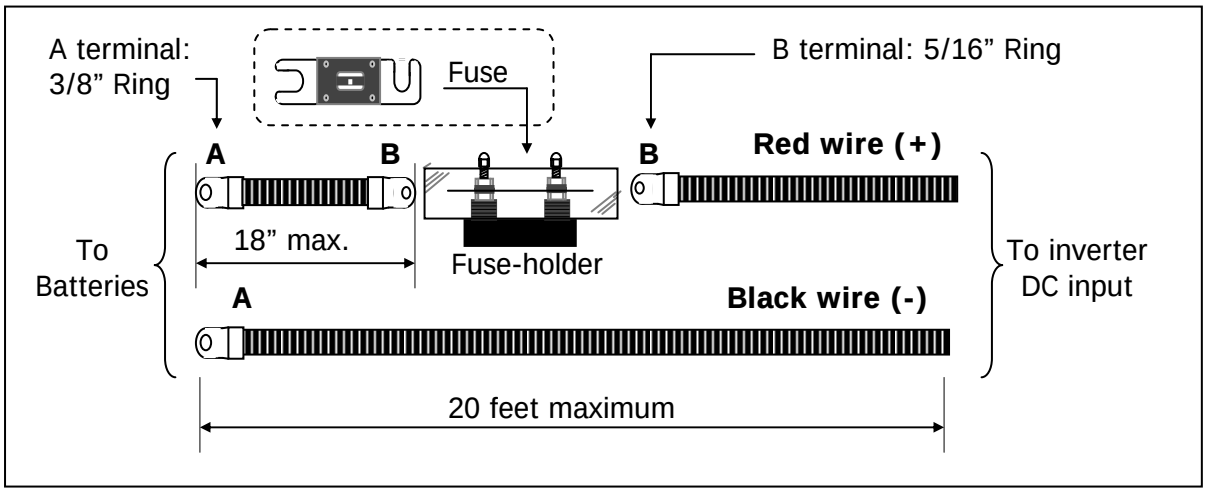


Figure 4: Inverter cable assembly

6.1.2 Charge Cable: This is the cable that runs from the batteries to vehicle alternator or OEM engine battery. Use 2-gauge cables and 250A fuse for small OEM alternators and 1/0-gauge and 350A for heavy-duty alternators.

6.1.3 Connecting the DC wires:

⚠	*Damage to the inverter not covered under warranty will occur if correct polarity is not observed when installing the DC input cables.*

- Refer to Figure 5: DC wiring diagram.
- Open the field-wiring compartment to access the DC input lugs.
- Unscrew the DC input lug POS (+) and NEG (-) screws.
- Remove the fuse from the fuseholder for cable installation.
- Remove 1 inch of insulation from the un-terminated ends of the red and black cables.
- Insert the stripped end of the red wire into the DC input lug labeled POS (+) and the stripped end of the black wire into the DC input lug labeled NEG (-). Tighten the lug screws to 10 Ft. Lbs.
- Tighten the cover DC cable strain relief screws to 1 Ft. Lb.
- Connect the end of the short red cable to a POS (+) battery post.
- Connect the terminated end of the black cable (neg. return cable) directly to a battery NEG (-) post (DO NOT connect to the chassis).
- Install the in-line fuse in the fuseholder that is within 18" of the positive post of the battery bank (a one-time spark will occur when this final DC connection is made). To determine the fuse size, refer to section 6.1.1.

6.1.4 Remote "On/Off" Switch: An optional customer supplied "On/Off" switch may be connected to the inverter. The remote switch will operate only if the main "On/Off" switch on the face of the inverter is turned ON.

- Open the inverter field-wiring compartment to access the DC input connector.
- Locate the violet wire labeled "Remote Switch Hookup" and remove it from the positive connector.
- Connect the violet wire to the load side of the "On/Off" remote switch.
- Using an 18-gauge wire, connect a fused (5 amp recommended) +12VDC battery voltage to the line side of the switch.
- The fuse should be mounted within 18 inches of the battery's positive post.
- All material used for the remote switch should be UL listed and installed per code.

6.1.5 Deep Cycle Batteries:

⚠	*Do not use vehicle-starting batteries; deep discharge cycles typical with inverter applications can shorten the life of this type of batteries.*

- Install at least one auxiliary deep cycle battery to feed the inverter directly. Depending on the application running time more batteries could be added if necessary. The vehicle alternator will recharge the batteries.
- It is recommended to mount the battery bank close to the inverter. The maximum recommended distance between the inverter and the battery bank is 20 feet.
- The battery compartment must be vapor-tight to the interior of the vehicle and vented directly to the exterior.
- Install several vent-plugs within one inch of the top of the battery compartment to allow for ventilation. Install a ventilation assembly as needed.
- Allow space around the battery and especially above the battery for inspection, and maintenance purposes.
- The battery should not be able to move more than 1 inch in any direction.

6.2 AC Wiring:

Remove the inverter field-wiring compartment cover plate to access the 120VAC, 60Hz input (“B3” or “T” option only) or the 120VAC, 60Hz output hardwire leads and follow the color code connections:

- Hot - Blue wire
- Hot - Brown wire
- Ground - Green wire

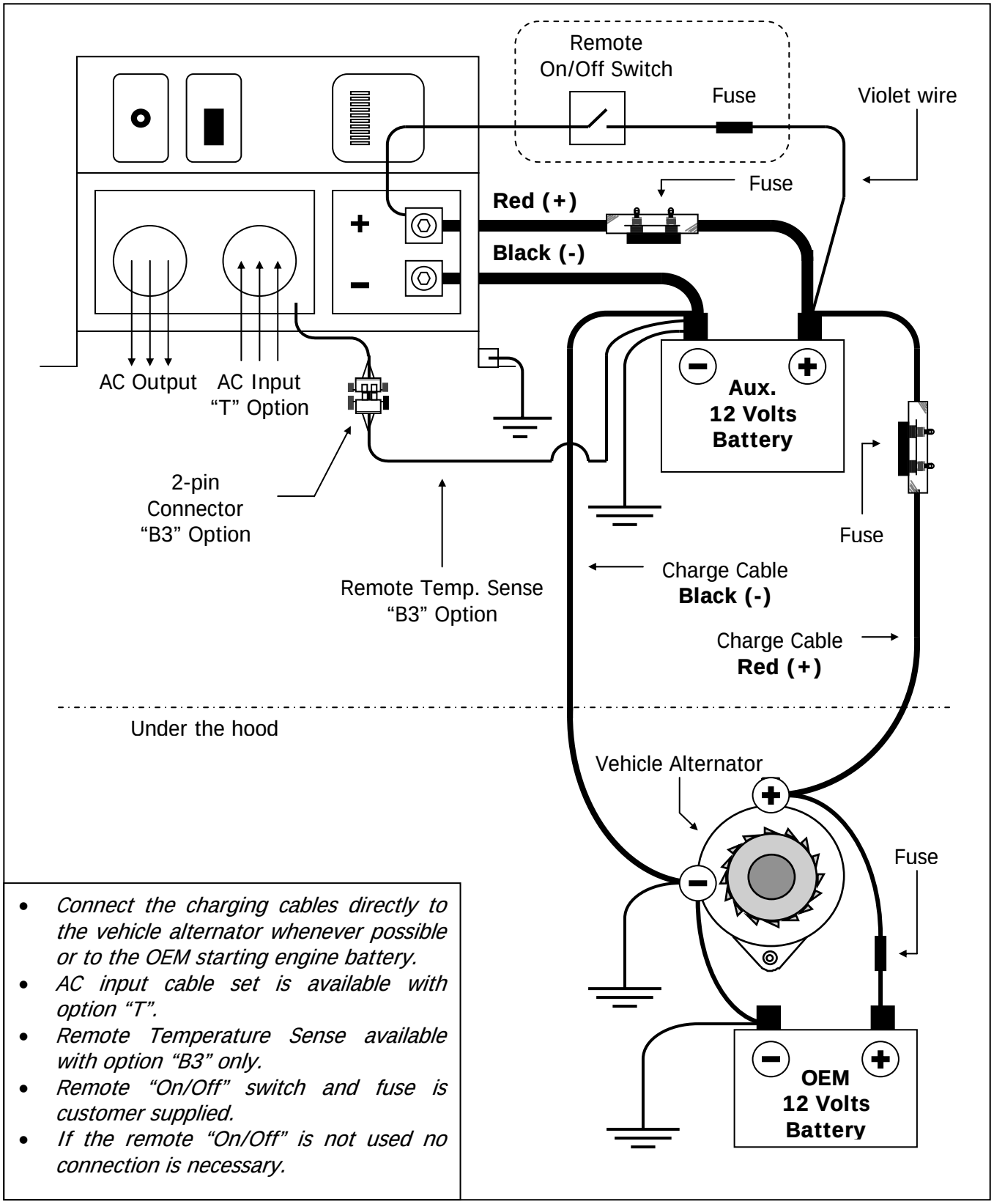
6.2.1 AC Output: The 220 VAC, 50 Hz current output produced by the inverter is provided behind the wiring compartment panel for direct hardwire leads.

⚠	*Do not connect another source of AC power directly to the output of the inverter. This will result in damage to the inverter that is not covered under warranty.*

6.2.2 AC Input: Inverters having the transfer switch “T” option must hardwire the AC input lead wires to an external power line 220VAC, 50Hz outlet. The cable clamp strain relief should be used to secure the field wires.

- The input circuit should have a maximum 15 amps circuit protection from the distribution panel.
- 15 amp circuit protection requires 14 gauge wire.

6.3 DC Wiring Diagram



- *Connect the charging cables directly to the vehicle alternator whenever possible or to the OEM starting engine battery.*
- *AC input cable set is available with option "T".*
- *Remote Temperature Sense available with option "B3" only.*
- *Remote "On/Off" switch and fuse is customer supplied.*
- *If the remote "On/Off" is not used no connection is necessary.*

Figure 5: DC wiring diagram

6.4 AC Wiring Diagram

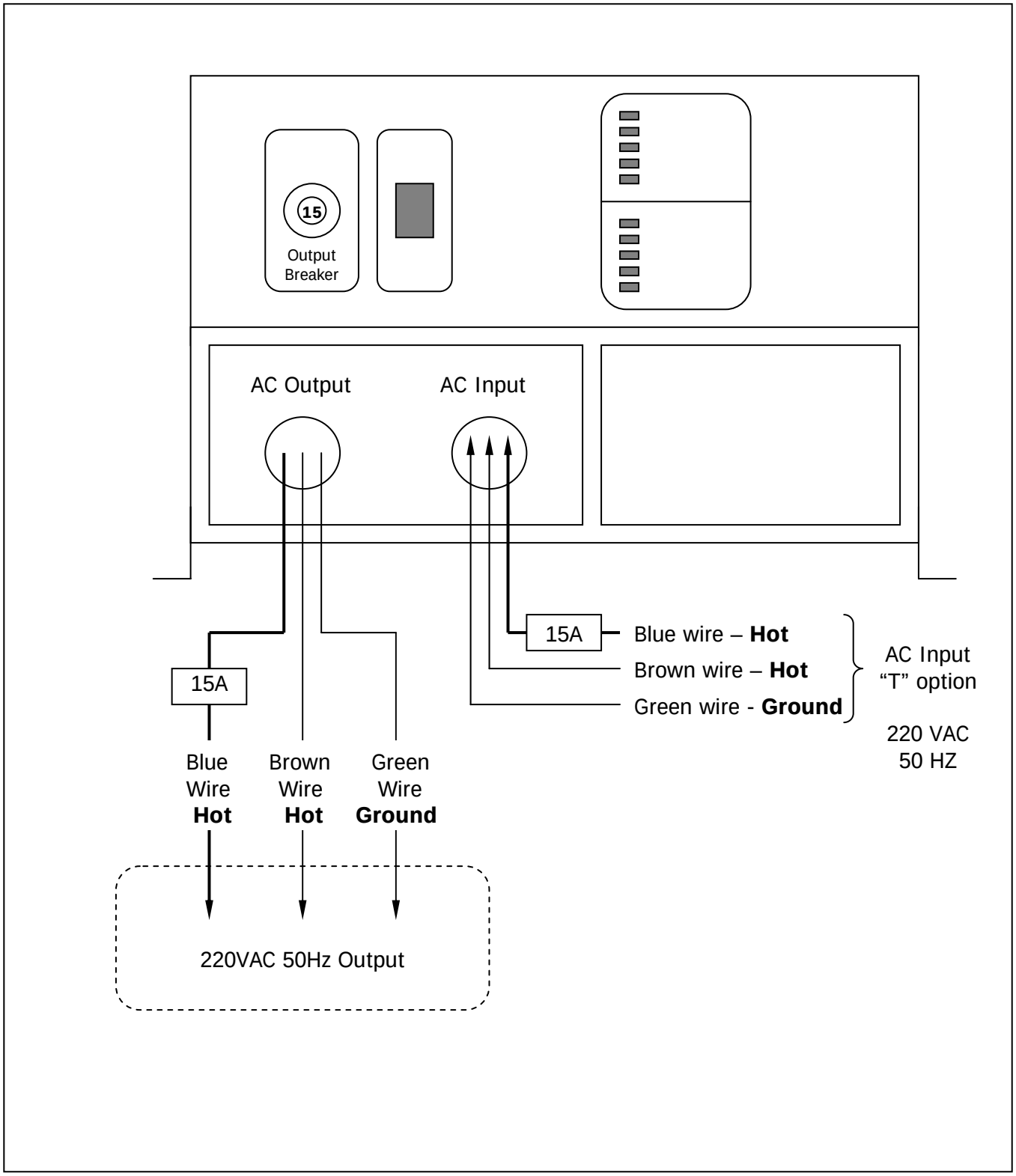


Figure 6: AC wiring diagram

Operation and Troubleshooting

7.1 Operation

7.1.1 Setting the Battery Size and Type – "B3" Option: The battery selector switch located at the right side of the chassis must be set according to the type and size of the battery bank the inverter is connected to as shown in table II below.

TABLE II: BATTERY SELECTOR SWITCH POSITION

BATTERY BANK SIZE (Amp-Hour)	DEEP CYCLE BATTERY TYPE	
	SEALED LEAD ACID	WET LEAD ACID
More than 200	A	C
Less than 200	B	D

TABLE III: BATTERY CHARGER VOLTAGES

BATTERY TEMPERATURE		WET CELL BATTERIES			SEALED BATERIES		
°F	°C	ACCEPT (Volts)	FLOAT (Volts)	CONDITIONING (Volts)	ACCEPT (Volts)	FLOAT (Volts)	CONDITIONING (Volts)
78	25	14.6	13.2	14.9 to 15 max.	14.2	13.2	14.4 to 15 max.

TABLE IV: BATTERY CHARGER TIME PERIODS

BATTERY BANK SIZE (Amp-Hour)	WET CELL TYPE BATTERIES			SEALED TYPE BATTERIES		
	BULK (max.)	ACCEPT (max.)	CONDITIONING (max.)	BULK (max.)	ACCEPT (max.)	CONDITIONING (max.)
Less than 200	6-hrs.	2-hrs.	3-hrs.	6-hrs.	2-hrs.	3-hrs.
Greater than 200	8-hrs.	3-hrs.	6-hrs.	8-hrs.	3-hrs.	4-hrs.

7.1.2 Turning the Inverter "ON": To turn the inverter ON, set the main switch to the "On" position. The green LED "Inverter Power" will come on. If the inverter has the "T" or "B3" options the green LED "Inverter Power" will come only in the event that there is no external power 220VAC, 50 Hz applied otherwise the green LED "External Power" LED will come on. If the remote switch is used, the inverter is turned ON or OFF by the remote switch. Turn the inverter OFF if not in use. There is an approximately 1 to 2 amp DC draw from the batteries at idle or no load.

7.2 Troubleshooting

Call or e-mail Customer Service Department for free phone consultation during business hours (central time zone) at: 1-800-553-6418 or 1-651-653-7000; fax: 1-651-653-7600; e-mail: inverterinfo@sensata.com

- A TRUE RMS voltmeter is required for accurate AC output voltage readings on quasi-sine inverters. Other voltmeters that use averaging circuitry will give an incorrect reading.
- Unplug all loads and connect a 100-watt light bulb to the inverter output. Observe the LEDs light coming on at the control panel then check the troubleshooting table.

Troubleshooting Table V

PROBLEM	POSSIBLE CAUSES OR SOLUTIONS
No LEDs: No power output. The SPS is not connected to the Battery Disconnect Switch; the battery voltage is below 9 volts DC, the SPS is not connected to the Module Disconnect Switch or a fault in the remote On/Off circuit.	Check the in-line fuses for continuity. Make sure the DC wires are clean and tight. Check the DC voltage at the SPS DC input. Check or bypass the remote On/Off circuit. Make sure that the Battery Disconnect Switch and the Module Disconnect Switch are turned on. Check for DC voltage at terminal 1 (Interlock).
Low battery: Red LED indicator light on steady. Indicates that the SPS has shut off due to a low battery voltage condition.	Fault in the battery wiring, battery capacity and voltage or an in-line fuse. This message will automatically clear or the SPS will shut off.
Overload: Red LED indicator light on steady. Indicates that the SPS has shut off due to an overload condition.	The SPS output wiring is shorting or loads exceed the inverter rating. This message will automatically clear or the SPS will shut off. Remove the short circuit or excessive load from the output, and then switch the SPS off then on.
High Temp: Red LED indicator light on steady. Indicates that the SPS has shut off due to high internal temperature. The unit will automatically turn back on when it has cooled down to 40°C (104°F). Red LED indicator light blinking. Indicates that the SPS has shut off due to high battery temperature 47°C – 50°C (117°F-122°F).	Verify that the SPS is in a vented compartment and that the fan is not blocked. High ambient temperatures combined with poor ventilation may also contribute to the shut down. Battery compartment is too hot and needs to cool down. The charger will automatically turn back on when it has cooled down to 40°C (104°F)
Overload & High Temp: Both of these red LED indicator lights are on steady. Indicates that the charger has shut off due to short or open temperature compensating sensor cable.	Temperature compensation sensor cable needs to be replaced.
Check battery - "B3" Option: Green LED indicator light. Indicates that the charger is operating in a low DC output voltage condition. The battery voltage must be higher than 9 volts for the charger to operate.	Shorted or defective battery. Make sure that the DC cable connections are tight and clean and not shorted, and that the proper wire gauge is used.
Indicates that the charger is operating in a high DC output voltage condition.	There is another source of battery charging or there is a defective battery charger. Disconnect and reconnect the external AC power to restart the battery charger.
Indicates that the SPS has shut off due to high battery voltage.	Check battery wiring or remove other source of battery charging, such as the vehicle alternator. Disconnect and reconnect the external AC power to restart the battery charger.

Warranty

SHIPPING TERMS: F.O.B. St. Paul Minnesota. Freight prepaid and billed, subject to prior credit approval.

MINIMUM ORDER: $50.00 Net Price

LOSS OR DAMAGE: Loss or damage in transit are the responsibility of the carrier. Any claim should be filed with the delivering transport company. Invoice, Bill of Lading and Delivery receipt with damage noted therein must accompany any claims for freight damage. Claims for shortage and lost shipments must be made in writing to Sensata Technologies, Power Controls White Bear, St. Paul, MN within 10 days of date of shipment. Claims not reported within this time frame will not be honored.

PRICES: Prices are subject to change without notice. All orders are subject to acceptance at the factory. We reserve the right to invoice prices in effect at time of shipment.

TERMS: Net 30 days with approved credit, credit card or C.O.D.

RETURN GOODS POLICY:
• No returned materials will be accepted without an accompanying Returned Materials Authorization Number (RMA) from the factory.
• Credit will be issued for returned goods to the original purchaser within 60 days of purchase, provided the inverter is returned to Sensata unused and not mounted. The amount of credit will be issued at Sensata's discretion based on the condition of the product.
• Customer must be in good standing with Sensata Technologies.
• Inverters that are discontinued, high-voltage (over 24vdc), special-order or used are excluded and will not be eligible for credit. Non-inverter items such as cable assemblies, fuses and fuse holders, will not be eligible for credit
• Support components supplied by Sensata vendors will be covered under that manufacturer's credit return policy.
• Customer pays return freight.

PLEASE SHIP AUTHORIZED RETURNS TO:
Sensata Technologies | Power Controls White Bear | 4467 White Bear Parkway | St. Paul, MN 55110
Return Freight Prepaid

LIMITED WARRANTY:
Sensata Technologies extends the following warranty to the original purchaser of those goods subject to the qualifications indicated. Sensata warrants to the original purchaser for use that the goods or any component thereof manufactured by Sensata will be free from defects in workmanship from the date of purchase for the period listed on the product label, provided such goods are installed, maintained and used in accordance with Sensata and the original manufacturer's written instructions. Damages caused by the misuse, undue care or obvious wear through use will not be covered by this warranty.

Components not manufactured by Sensata, but used within the assembly provided by Sensata, are subject to the warranty period as specified by the individual manufacturer of said component, provided such goods are installed, maintained and used in accordance with Sensata and the manufacturer's written instructions.

Sensata's sole liability and the Purchaser's sole remedy for a failure of goods under this limited warranty and for any and all claims arising out of the purchase and use of the goods, shall be limited to the repair or replacement of the goods that do not conform to this warranty.

To obtain repair or replacement service under the limited warranty, the purchaser must contact the factory for a Return Material Authorization (RMA). Once obtained, send the Return Material Authorization Number along with the defective part or goods to:
Sensata Technologies, Power Controls White Bear, 4467 White Bear Parkway, St. Paul, MN 55110. Return Freight Prepaid.
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SENSATA TECHNOLOGIES ASSUMES NO LIABILITY IN CONNECTION WITH THE INSTALLATION OR USE OF THE PRODUCT, EXCEPT AS STATED IN THIS LIMITED WARRANTY. SENSATA TECHNOLOGIES WILL IN NO EVENT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

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